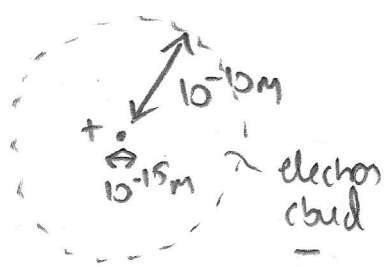
PRE-U REVISION NOTES. QUANTUM & ATOMIC PHYSICS AF 3/19

QUANTUM MECHANICS I: BLACK BODY RADIATION & PLANCK LAW PHOTOELECTRIC EFFECT, ELECTRON DIFFRACTION, BOHR ATOM & H SPECTRA

- Democritus (460 BC - 370 BC) proposes Matter consists of 'uncuttable' atomos components ATOMS
- This does not become Scientific orthodoxy till the 20th Century AD!
- RUTHERFORD experiment showed atoms comprise of a tiny +ve charged nucleus ($\sim 10^{-15}$ m) surrounded by a 'cloud' of -ve charged electrons. Most of the mass is in the nucleus.



So if nucleus is a meter rule the electrons extend from Winchester to London! (100 km = 10^5 m)

Note # of atoms in a cube ('marble sized' of width 3.6 cm

$$\approx \left(\frac{3.6\times 10^{-2}}{10^{-10}}\right)^3 \approx \boxed{5\times 10^{25}}$$

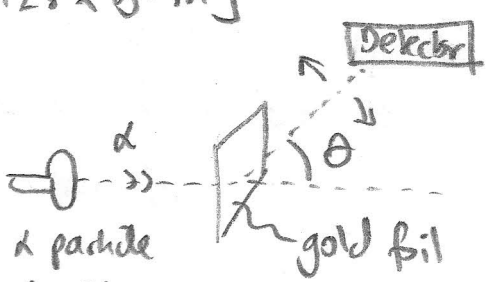
This is similar to the # marbles that would form an Earth!

$$\left(\frac{1.28\times 10^{7}\ \text{m}}{3.6\times 10^{-2}}\right)^3 \approx \boxed{4.4\times 10^{25}}$$

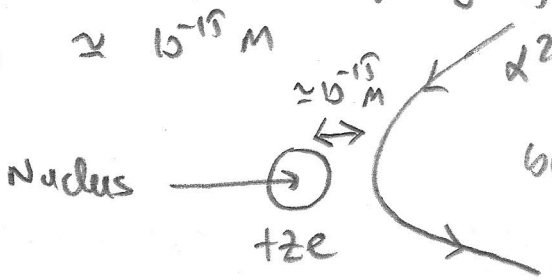
[Earth diameter is 1.28×10^7 m]

.... SO ATOMS ARE VERY SMALL!

Rutherford exp determined the statistics* of α particles (He nuclei from radioactive decay) scattered (by θ) by a sheet of very thin gold foil. The scattering law is consistent with the nucleus behaving **like a point particle** of charge $2e$ ($Z = 79$ for gold), with closest approach (without recoil) $\approx 10^{-15}$ m



[Detector moves in a circular arc]



* See Nuclear notes.